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CLAIMS

1. A cigarette manufacturing apparatus comprising:

a tobacco rod maker for making double length tobacco rods;

5 a tipper for applying filters to tobacco rods to form filter tipped cigarettes;

a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;

10 wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and a plurality of devices for affecting parameters of the rod maker, the tipper or the cigarettes being manufactured, and wherein one or more of said monitoring devices and said parameter affecting devices both monitors and affects parameters;

15 a controller for controlling the plurality of devices on the tipper and the rod maker, including varying one or more parameters of the rod maker, the tipper or the cigarettes being manufactured, in response to conditions monitored by one or more of said devices; and

20 a field bus, the plurality of devices and the controller each being connected to the field bus.

2. Apparatus according to claim 1, further comprising a plurality of synchronous motors controlled by a motion controller.

3. Apparatus according to claim 2, wherein the motion  
25 controller is connected to the controller.

4. Apparatus according to claim 2 ~~or 3~~, wherein the motion controller is connected to the field bus.

5. Apparatus according to claim 2, ~~2 or 4~~, wherein the  
30 plurality of motors includes a cut-off motor for driving a device for cutting individual tobacco rods, a suction chamber motor for driving a suction belt, a garniture belt drive motor, and a hopper motor for controlling the rate at which tobacco is drawn from a hopper.

6. Apparatus according to claim 5, wherein the rotational  
35 speed of the suction chamber motor, the garniture belt drive

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motor and the hopper motor are synchronised to the rotational speed of the cut-off motor.

5 7. Apparatus according to claim 5, wherein the rotational speed of the cut-off motor, the suction chamber motor, the garniture belt drive motor and the hopper motor are synchronised to a virtual axis.

10 8. Apparatus according to claim 5, ~~6 or 7~~, wherein the plurality of motors further includes an ecreteur motor for driving a dense end cam and a pair of ecreteur discs, a capstan motor, and a printer motor for driving a printer to print onto the cigarette wrapping paper.

9 Apparatus according to claim 8, wherein the ecreteur motor and the printer motor are speed and position synchronised to the cut-off motor or the virtual axis.

15 10. Apparatus according to claim 5, ~~6 or 7~~, wherein the plurality of motors further includes a tipper motor for driving a tipper drum train, wherein the tipper motor is synchronised to the position of the cut-off motor or to the virtual axis.

20 11. Apparatus according to ~~any preceding claim~~ <sup>1</sup> further comprising at least one human-machine interface (HMI) connected to the field bus.

25 12. Apparatus according to claim 11, wherein the at least one HMI comprises a rod maker HMI and a tipper HMI, each of the rod maker HMI and the tipper HMI being connected to the controller via the fieldbus.

13. Apparatus according to ~~any of claims 1 to 10~~ <sup>1</sup>, comprising at least one human-machine interface (HMI) connected to the controller.

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14. Apparatus according to claim 13, wherein the at least one HMI comprises a rod maker HMI and a tipper HMI, each of the rod maker HMI and the tipper maker HMI being connected to the controller.

5 15. Apparatus according to ~~any of claims 11 to 14~~, wherein the at least one HMI is connected to a communications network.

16. Apparatus according to ~~any preceding claim~~, wherein at least one of the plurality of devices is connected to the field bus via an interface.

10 17. Apparatus according to ~~any of claims 1 to 15~~, wherein at least one of the devices is a field device.

18. Apparatus according to ~~any of claims 1 to 15~~, wherein at least one of the plurality of devices transmits data including diagnostic data to the controller over the field bus.

15 19. A cigarette manufacturing apparatus comprising:  
a tobacco rod maker for making double length tobacco rods;

a tipper for applying filters to tobacco rods to form filter tipped cigarettes;

20 a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;

wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and a plurality of devices for affecting parameters of the rod maker, the tipper or the cigarette being manufactured, and wherein one or more of said monitoring devices and said parameter affecting devices both monitors and affects parameters;

25 a first controller for controlling the plurality of devices on the tipper and the rod maker, including varying parameters of the rod maker, the tipper or the cigarettes being manufactured, in response to conditions monitored by one or more of said devices; and

30 a second controller for providing tipper, rod maker and cigarette information to an operator and for communicating input data from the user to one or both of the first and second controllers.

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20. Apparatus according to claim 19, wherein the second controller includes at least one Human/Machine Interface (HMI) and communicates with the first controller, for communicating tipper, rod maker and cigarette data to an operator and for communicating input data to the first controller.

21. Apparatus according to claim 19, wherein the second controller comprises a tipper controller communicating with a tipper HMI and a rod maker controller communicating with a rod maker HMI.

22. Apparatus according to claim 21, wherein the tipper controller and the rod maker controller each comprises a PC or similar device.

23. Apparatus according to claim 21 ~~or 22~~, wherein the tipper controller and the rod maker controller each comprise an HMI.

24. Apparatus according to claim 21, ~~22 or 23~~, wherein the tipper controller and the rod maker controller are interconnected.

25. Apparatus according to ~~any of claims 19 to 24~~, wherein the first controller and at least some of the rod maker and tipper devices are connected to a fieldbus.

26. Apparatus according to claim 25, wherein the second controller is connected to the fieldbus.

27. Apparatus according to ~~any of claims 19 to 26~~, wherein the second controller is connected to an external communications network.

28. Apparatus according to ~~any of claims 19 to 27~~, further comprising a motion controller controlled by the first controller for synchronising a plurality of motors on one or both of the rod maker and the tipper.

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29. Apparatus according to claim 28, wherein the plurality of motors includes a cut-off motor for driving a device for cutting individual tobacco rods and the remainder of the plurality of motors is synchronised to the cut-off motor.

5 30. Apparatus according to claim 28, wherein the plurality of motors is synchronised to a virtual axis.

B 31. Apparatus according to claim ~~26, 27 or 28~~, wherein the motion controller is connected to the field bus.

D 10 32. Apparatus according to ~~any of claim 11 to 15 or 20 to 24~~, wherein the HMI is configured to display to the operator one of a hierarchical set of display screens.

33. Apparatus according to claim 32, wherein at least one of the set of screens includes rows areas representing buttons for controlling rod maker or tipper functions.

B 15 34. Apparatus according to claim 32 ~~or 33~~, wherein the HMI is configured to display diagnostic information from tipper or rod maker components.

20 35. A method of controlling the manufacture of cigarettes by an apparatus comprising a tobacco rod maker and tipper interconnected by a rod transfer apparatus, the method comprising the steps of:

providing a field bus and a machine controller connected to the field bus;

25 connecting a plurality of devices to the field bus for monitoring and a plurality of devices for affecting parameters of the rod maker, the tipper or the cigarettes being manufactured, one or more of said monitoring devices and said parameter affecting devices both monitoring and affecting parameters;

monitoring the field bus from the controller for data from the devices; and

30 automatically adjusting one or more parameters of the tipper or rod maker in accordance with the information content of the data received.

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36 A method according to claim 35, further comprising providing a second controller to interface with the machine controller, wherein the machine controller receives data from and sends data to the second controller.

B<sub>5</sub> 37. A method according to claim 35 ~~or 36~~, wherein the machine controller looks for a signal on the field bus indicating a machine stop command input from the second controller and, if the machine stop signal is present, sends a stop signal to the field devices.

B<sub>10</sub> 38. A method according to claim 35, ~~36 or 37~~, wherein the machine controller looks for a signal on the field bus indicating an emergency stop condition or indicating that a protective guard on the rod maker or tipper is not in place and, if the signal is present, sends a stop signal to the field device.

B<sub>15</sub> 39. A method according to ~~any of claims 35 to 38~~, wherein the machine controller looks for a signal on the field bus indicating a fault condition at one of the field devices and, if the fault condition signal is present, sends a stop signal to the field device.

B<sub>20</sub> 40. A method according to ~~any of claims 35 to 37~~, wherein the machine controller also communicates the stop signal to the second controller together with information identifying the cause of the stop signal.

25 41. A method according to claim 40, wherein the information sent to the second controller includes diagnostic information and component identification information.

B<sub>30</sub> 42. A method according to ~~any of claims 35 to 41~~, wherein the machine controller looks for a signal on the field bus warning of a non-ideal condition at one of the field devices and, if the warning signal is present, sends a warning signal to the second controller.

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43. A method according to ~~any of claims 35 to 42~~, wherein the field of devices include a cut-off motor which controls the cutting of cigarette rods from a continuous length of wrapped tobacco produced by the rod maker and a plurality of further motors synchronised to the cut-off motor.

44. A method according to ~~any of claims 35 to 42~~, wherein the field devices include a cut-off motor which controls the cutting of cigarette rods from a continuous length of wrapped tobacco produced by the rod maker and a plurality of further motors, the further motors and the cut-off motor being synchronised to a virtual axis.

45. A method according to claim 43 or 44, wherein the synchronised motors include motors synchronised by speed and motors synchronised by position.

46. A method according to ~~any of claims 35 to 45~~, wherein the machine controller looks for a signal on the field bus indicating that a wrapping paper bobbin or a tipping paper bobbin is nearly exhausted and, if the signal is detected, initiates a routine to splice a fresh paper bobbin onto the present paper bobbin.

47. A cigarette manufacturing apparatus comprising:  
a tobacco rod maker for making double length tobacco rods;  
a tipper for applying filters to tobacco rods to form filter tipped cigarettes;  
a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;  
a plurality of synchronised motors each for driving a respective operation in the tipper or the rod maker;  
~~wherein each of the tipper and the rod maker further~~  
includes a plurality of devices for monitoring and a plurality of devices for affecting parameters of the rod maker, the tipper or the cigarettes being manufactured, and wherein one or more of said monitoring devices and said parameter affecting devices both monitors and affects parameters.

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a motion control device for controlling the plurality of synchronised motors;

5 a system for controlling the plurality of devices on the tipper and the rod maker, including varying one or more parameters of the rod maker, the tipper or the cigarettes to be manufactured, in response to conditions monitored by one or more of said devices, the motion control devices being connected to the system controller; and

10 a field bus, the plurality of devices and the controller each being connected to the communications network.

48. A cigarette manufacturing apparatus comprising:

a tobacco rod maker for making double length tobacco rods;

15 a tipper for applying filters to tobacco rods to form filter tipped cigarettes;

a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;

20 wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and a plurality of devices for affecting parameters of the rod maker, the tipper or the cigarettes being manufactured, and wherein one or more of said monitoring devices and said parameter affecting devices both monitors and affects parameters;

25 a control network, the plurality of devices being coupled to the control network;

30 a first controller connected to the control network for controlling the plurality of devices on the tipper and the rod maker, including varying one or more parameters of the rod maker, the tipper or the cigarettes to be manufactured, in response to the conditions monitored by one or more of said devices;

a second controller coupled to the first controller and including at least one HMI for providing tipper, rod maker and cigarette information to an operator and for communicating input data from the user to the first controller.

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Claims

1. A cigarette manufacturing apparatus comprising:  
a tobacco rod maker for making double length tobacco rods;  
a tipper for applying filters to tobacco rods to form filter tipped cigarettes;  
a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;  
wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and/or affecting parameters of the rod maker, the tipper or the cigarettes being manufactured;  
a controller for controlling the plurality of devices on the tipper and the rod maker; and  
a field bus, the plurality of devices and the controller each being connected to the field bus.
2. Apparatus according to claim 1, further comprising a plurality of synchronous motors controlled by a motion controller.
3. Apparatus according to claim 2, wherein the motion controller is connected to the controller.
4. Apparatus according to claim 2 or 3, wherein the motion controller is connected to the fieldbus.
5. Apparatus according to claim 2, 3 or 4, wherein the plurality of motors includes a cut-off motor for driving a device for cutting individual tobacco rods, a suction chamber motor for driving a suction belt, and a garniture belt drive motor, and a hopper motor for controlling the rate at which tobacco is drawn from a hopper.
6. Apparatus according to claim 5, wherein the rotational speed of the suction chamber motor, the garniture belt drive

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motor and the hopper motor are synchronised to the rotational speed of the cut-off motor.

5 7. Apparatus according to claim 5, wherein the rotational speed of the cut-off motor, the suction chamber motor, the garniture belt drive motor and the hopper motor are synchronised to a virtual axis.

10 8. Apparatus according to claim 5, 6 or 7, wherein the plurality of motors further includes an ecreteur motor for driving a dense end cam and a pair of ecreteur discs, a capstan motor, and a printer motor for driving a printer to print onto the cigarette wrapping paper.

9 Apparatus according to claim 8, wherein the ecreteur motor and the printer motor are speed and position synchronised to the cut-off motor or the virtual axis.

15 10. Apparatus according to claim 5, 6 or 7, wherein the plurality of motors further includes a tipper motor for driving a tipper drum train, wherein the tipper motor is synchronised to the position of the cut-off motor or to the virtual axis.

20 11. Apparatus according to any preceding claim further comprising at least one human-machine interface (HMI) connected to the field bus.

25 12. Apparatus according to claim 11, wherein the at least one HMI comprises a rod maker HMI and a tipper HMI, each of the rod maker HMI and the tipper HMI being connected to the controller via the fieldbus.

13. Apparatus according to any of claims 1 to 10, comprising at least one human-machine interface (HMI) connected to the controller.

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14. Apparatus according to claim 13, wherein the at least one HMI comprises a rod maker HMI and a tipper HMI, each of the rod maker HMI and the tipper HMI being connected to the controller

5 15. Apparatus according to any of claims 11 to 14, wherein the at least one HMI is connected to a communications network.

16. Apparatus according to any preceding claim, wherein at least one of the plurality of devices is connected to the field bus via an interface.

10 17. Apparatus according to any of claims 1 to 15, wherein at least one of the devices is a field device.

18. Apparatus according to any of claims 1 to 15, wherein at least one of the plurality of devices transmits data including diagnostic data to the controller over the fieldbus.

15 19. A cigarette manufacturing apparatus comprising:  
a tobacco rod maker for making double length tobacco rods;  
a tipper for applying filters to tobacco rods to form filter tipped cigarettes;  
a transfer apparatus for transferring double length  
20 tobacco rods from the rod maker to the tipper;  
wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and/or affecting parameters of the rod maker, the tipper or the cigarettes being manufactured;  
25 a first controller for controlling the plurality of devices on the tipper and the rod maker; and  
a second controller for providing tipper, rod maker and cigarette information to an operator and for communicating input data from the user to one or both of the first and second  
30 controllers.

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20. Apparatus according to claim 19, wherein the second controller includes at least one Human/Machine Interface (HMI) and communicates with the first controller, for communicating tipper, rod maker and cigarette data to an operator and for communicating input data to the first controller.

21. Apparatus according to claim 19, wherein the second controller comprises a tipper controller communicating with a tipper HMI and a rod maker controller communicating with a rod maker HMI.

22. Apparatus according to claim 21, wherein the tipper controller and the rod maker controller each comprises a PC or similar device.

23. Apparatus according to claim 21 or 22, wherein the tipper controller and the rod maker controller each comprise an HMI.

24. Apparatus according to claim 21, 22 or 23, wherein the tipper controller and the rod maker controller are interconnected.

25. Apparatus according to any of claims 19 to 24, wherein the first controller and at least some of the rod maker and tipper devices are connected to a fieldbus.

26. Apparatus according to claim 25, wherein the second controller is connected to the fieldbus.

27. Apparatus according to any of claims 19 to 26, wherein the second controller is connected to an external communications network.

28. Apparatus according to any of claims 19 to 27, further comprising a motion controller controlled by the first controller for synchronising a plurality of motors on one or both of the rod maker and the tipper.

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29. Apparatus according to claim 28, wherein the plurality of motors includes a cut-off motor for driving a device for cutting individual tobacco rods and the remainder of the plurality of motors is synchronised to the cut-off motor.
- 5 30. Apparatus according to claim 28, wherein the plurality of motors is synchronised to a virtual axis.
31. Apparatus according to claim 26,27 or 28, wherein the motion controller is connected to the fieldbus.
- 10 32. Apparatus according to any of claims 11 to 15 or 20 to 24, wherein the HMI is configured to display to the operator one of a hierarchical set of display screens.
33. Apparatus according to claim 32, wherein at least one of the set of screens includes rows areas representing buttons for controlling rod maker or tipper functions.
- 15 34. Apparatus according to claim 32 or 33, wherein the HMI is configured to display diagnostic information from tipper or rod maker components.
- 20 35. A method of controlling the manufacture of cigarettes by an apparatus comprising a tobacco rod maker and tipper interconnected by a rod transfer apparatus, the method comprising the steps of:
- providing a field bus and a machine controller connected to the field bus;
  - connecting a plurality of devices to the field bus,
  - 25 for monitoring and/or affecting parameters of the rod maker, the tipper or the cigarettes being manufactured;
  - monitoring the field bus from the controller for data from the devices;
  - and adjusting one or more parameters of the tipper or
  - 30 rod maker in accordance with the information content of the data received.

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36 A method according to claim 35, further comprising providing a second controller to interface with the machine controller, wherein the machine controller receives data from and sends data to the second controller.

5 37. A method according to claim 35 or 36, wherein the machine controller looks for a signal on the field bus indicating a machine stop command input from the second controller and, if the machine stop signal is present, sends a stop signal to the field devices.

10 38. A method according to claim 35, 36 or 37, wherein the machine controller looks for a signal on the field bus indicating an emergency stop condition or indicating that a protective guard on the rod maker or tipper is not in place and, if the signal is present, sends a stop signal to the field device.

15 39. A method according to any of claims 35 to 38, wherein the machine controller looks for a signal on the field bus indicating a fault condition at one of the field devices and, if the fault condition signal is present, sends a stop signal to the field device.

20 40. A method according to any of claims 35 to 37, wherein the machine controller also communicates the stop signal to the second controller together with information identifying the cause of the stop signal.

25 41. A method according to claim 40, wherein the information sent to the second controller includes diagnostic information and component identification information.

30 42. A method according to any of claims 35 to 41, wherein the machine controller looks for a signal on the field bus warning of a non-ideal condition at one of the field devices and, if the warning signal is present, sends a warning signal to the second controller.

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43. A method according to any of claims 35 to 42, wherein the field devices include a cut-off motor which controls the cutting of cigarette rods from a continuous length of wrapped tobacco produced by the rod maker and a plurality of further motors  
5 synchronised to the cut-off motor.
44. A method according to any of claims 35 to 42, wherein the field devices include a cut-off motor which controls the cutting of cigarette rods from a continuous length of wrapped tobacco produced by the rod maker and a plurality of further motors, the  
10 further motors and the cut-off motor being synchronised to a virtual axis.
45. A method according to claim 43 or 44, wherein the synchronised motors include motors synchronised by speed and motors synchronised by position.
- 15 46. A method according to any of claims 35 to 45, wherein the machine controller looks for a signal on the field bus indicating that a wrapping paper bobbin or a tipping paper bobbin is nearly exhausted and, if the signal is detected, initiates a routine to splice a fresh paper bobbin onto the present paper bobbin.
- 20 47. A cigarette manufacturing apparatus comprising:  
a tobacco rod maker for making double length tobacco rods;  
a tipper for applying filters to tobacco rods to form filter tipped cigarettes;  
25 a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;  
a plurality of synchronised motors each for driving a respective operation in the tipper or the rod maker;  
wherein each of the tipper and the rod maker further  
30 includes a plurality of devices for monitoring and/or affecting parameters of the rod maker, the tipper or the cigarettes being manufactured;

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a motion control device for controlling the plurality of synchronised motors;

5 a system controller for controlling the plurality of devices on the tipper and the rod maker, the motion control device being connected to the system controller; and

a field bus, the plurality of devices and the controller each being connected to the communications network.

48. A cigarette manufacturing apparatus comprising:

10 a tobacco rod maker for making double length tobacco rods;

a tipper for applying filters to tobacco rods to form filter tipped cigarettes;

a transfer apparatus for transferring double length tobacco rods from the rod maker to the tipper;

15 wherein each of the tipper and the rod maker comprises a plurality of devices for monitoring and/or affecting parameters of the rod maker, the tipper or the cigarettes being manufactured;

20 a control network, the plurality of devices being coupled to the control network;

a first controller connected to the control network for controlling the plurality of devices on the tipper and the rod maker; and

25 a second controller coupled to the first controller and including at least one HMI for providing tipper, rod maker and cigarette information to an operator and for communicating input data from the user to the first controller.